

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
4 July 2002 (04.07.2002)

PCT

(10) International Publication Number
WO 02/051529 A1

(51) International Patent Classification⁷: **B01D 63/12**

(21) International Application Number: **PCT/DK01/00837**

(22) International Filing Date:
19 December 2001 (19.12.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PA 2000 01936 27 December 2000 (27.12.2000) DK

(71) Applicant (for all designated States except US): **DSS
DANISH SEPARATION SYSTEMS A/S [DK/DK]; 10
Stavangervej, DK-4900 Nakskov (DK).**

(72) Inventor; and

(75) Inventor/Applicant (for US only): **LARSEN, Knud,
Verner [DK/DK]; 20 Vestre Landevej, DK-4930 Maribo
(DK).**

(74) Agent: **CHAS. HUDE A/S; 33, H.C. Andersens Boule-
vard, DK-1780 Copenhagen V (DK).**

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

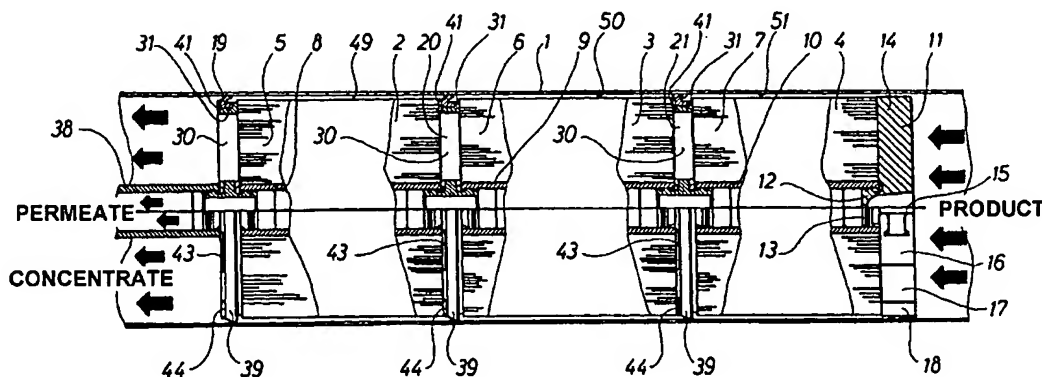
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— of inventorship (Rule 4.17(iv)) for US only

Published:
— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **SANITARY FILTRATION PLANT WITH HELICAL FILTER ELEMENTS**



(57) Abstract: A sanitary filtration plant comprises an oblong, tubular pressure vessel (1), which includes one or more helical filter elements (2 to 4). Each helical filter element comprises a spiral-wound filter member (5 to 7) and a central tube (8 to 10). At the end being the outlet end, each helical filter element (2 to 4) comprises a supporting means (19, 20, 21) formed as a wheel with a hub (22), spokes and a rim (31) and centrally a transition means (35). The transition means is adapted to ensure a sealing flow connection between abutting ends of central tubes (8 to 10). In addition, each supporting means (18 to 21) comprises plane sides for abutment against the ends of the filter members of the respective helical filter elements (19 to 21), and along the external periphery they comprise a sealing means (39) for a sealing abutment against the inner side of the pressure vessel (1). The plane side being the downstream face of each supporting means (19 to 21) during ordinary operation of the plant is provided with a plurality of recesses (41, 43 and 44). Each recess extends between an opening between the spokes and the external periphery of the rim (31).

Sanitary filtration plant with helical filter elements.

Technical Field

The invention relates to a sanitary filtration plant comprising an oblong, tubular pressure vessel, which includes one or more helical filter elements, each helical filter
5 element comprising a spiral-wound filter member and a central tube as well as a supporting means at one end which represents the outlet end while the plant is operating, said supporting means being in form of a wheel with a hub, spokes and rim and centrally being provided with a transition member which is adapted to ensure a sealing flow connection between adjacent ends of adjacent central tubes, and where
10 each supporting means comprises plane sides for abutment against the ends of the filter members of the adjacent respective helical filter element(s) and along the external periphery is provided with a sealing means for a sealing abutment against the inner side of the pressure vessel. The invention relates furthermore to a supporting means to be used in such a sanitary filtration plant.

15 Background Art

Sanitary filtration plants of the above type are known which comprise joined helical filter elements connected in series and mounted inside a pressure pipe, and where the product in question passes through the filter member while subjected to a suitable pressure difference. From the filter member, the permeate flows into the connected
20 central tubes and leaves said tubes while separated from the concentrate. The concentrate passes through the filter member and leaves the pressure pipe while separated from the permeate. The helical filter elements can be of a length of approximately 0.5 to 1.0 m and have a tendency to be subjected to an axial displacement of the filter member relative to the central tube, viz. a so-called telescoping. Therefore, supporting
25 ing means are arranged between the helical filter elements in order to counteract said displacement, said supporting means being so-called anti-telescoping devices, viz.

ATD's. These supporting means also serve to ensure that the product to be filtered does not pass the filter elements freely between the external periphery thereof and the inner side of the tubular pressure vessel as a slit is provided at this location. This slit originates from an overdimensioning of the pressure vessel and allows an easy
5 mounting and replacement of the filter elements. The latter prevention of the free flow through this slit is enhanced by the supporting means comprising a sealing means along the external periphery.

A filtration device with supporting means of a similar type is known from US-PS No. 4,517,085. However, this helical filtration device is not suited for use as a sanitary
10 filtration plant.

A sanitary filtration plant used inter alia within the dairy, the medicine and the food-stuff industry presents very high requirements to the hygiene. A continuous use of a sanitary filtration plant often necessitates a cleaning, such as once or twice a day, whereby a cleaning fluid passes through the plant. It is important in connection with
15 such a cleaning process that residues of the product in question are removed.

Brief Description of the Invention

The object of the invention is to provide a sanitary filtration plant which ensures such an efficient cleaning.

This object is according to the invention obtained by the filtration plant described in
20 the introduction being characterised in that a plurality of recesses extending between an opening between spokes and the external periphery of the rim is provided in the plane side of the supporting means being the downstream face while the plant is operating.

As a result, a controlled flow is ensured of both the product to be subjected to a

filtration and the cleaning fluid on the downstream face of the supporting means in such a manner that a flow of the fluid in question is carried directly into the area behind the sealing means of the supporting means, whereby this area behind the sealing means is washed with the result that a replacement of both the product to be
5 subjected to a filtration and the cleaning fluid is ensured. In addition, the pressure prevailing inside the slit on the outer side of each helical filter element is equalized along the entire length of said helical filter element with the result that the efficiency of the plant is increased and the above telescoping is minimized.

According to the invention it is particularly advantageous when a recess extends from
10 each opening between the spokes of the supporting means.

The invention relates also to a supporting means to be used in a sanitary filtration plant of the above type. This supporting means is according to the invention characterised in that it is provided with a plurality of recesses in the plane side being the downstream face while the plant is operating, said recesses extending between an
15 opening between the spokes and the external periphery of the rim.

Brief Description of the Drawings

The invention is explained in greater detail below with reference to the accompanying drawings, in which

Fig. 1 is a cross-sectional view through a portion of a filtration plant according to the
20 invention, whereby parts have been omitted for the sake of clarity, and is a sectional view taken along the central line and in form of solid lines below said central line through the supporting means provided between the helical filter elements,

Fig. 2 illustrates on a larger scale the supporting means, seen from the downstream face thereof, and

Fig. 3 is a sectional view taken along the line A-A of Fig. 2 of the supporting means shown in Fig. 2.

Best Mode for Carrying Out the Invention

The filtration plant shown in Fig. 1 comprises a pressure pipe 1, in which three
5 helical filter elements 2, 3 and 4 are mounted. Each helical filter element 2, 3 and 4 comprises a spiral-wound filter member 5, 6 and 7, respectively, arranged about a central tube 8, 9 and 10, respectively. These helical filter elements 2 to 4 are of a conventionally known type.

A plug means 11 is provided at the right end of the row of helical filter elements 2
10 to 4 shown in the drawing, said plug means 11 comprising a centrally projecting projection 12 with an external seal 13 for sealingly engaging and closing the central tube 10. This plug means is of a conventionally known type with radially projecting wings 14, 15, 16, 17 and 18 for a supporting abutment against the adjacent end of the filter member 7.

15 A supporting means 19, 20 and 21 is arranged between the helical filter elements 2 to 4 and at the left end of the row of said filter elements 2 to 4 in the drawing. As shown in Figs. 2 and 3, each supporting means comprises a hub 22, radial spokes 23 to 30 as well as a rim 31 with the result that these supporting means are of a wheel--like shape. A projecting projection 32, 33 is centrally arranged on each side of the
20 supporting means, said projections 32, 33 defining a through bore 34 centrally arranged in the hub. These projections serve to form a transition means 35 between abutting ends of the central tube of the respective helical filter elements 2 to 4, said projecting projections 32 and 33 sealingly engaging said central tubes 8 to 10 by means of a circumferential sealing means 36, 37, respectively.

25 The transition means at the left end of the row of filter elements 2 to 4 shown in Fig.

1 co-operates with a centrally arranged tube 38 serving to carry the permeate away from the filtration plant.

Fig. 3 illustrates particularly clearly that the supporting means 19, 20 and 21 externally comprise a circumferential lip seal 39 which is received and vulcanized in a circumferential groove 40.

As particularly clearly shown in Figs. 2 and 3, but also in Fig. 1, radial recesses 41 to 48 are provided on one side of each supporting means 19 to 21, and in greater detail on the side of the supporting means forming the downstream face of said supporting means while the filtration plant is operating. These recesses 41 to 48 extend between their respective openings between the spokes 23 to 30 and the outer side of the rim 31.

A product to be filtered by means of the filtration plant is carried through the row of filter elements 2, 3 and 4, cf. the arrows at the right end of Fig. 1. The permeate or the filtrate leaves the filter members 5 to 7 in a conventionally known manner and flows into the central tubes 8, 9 and 10 and then out of said tubes through the tube 38 to the left of Fig. 1. The remaining portion of the product to be filtered, viz. the concentrate, leaves also to the left so as to be drained off in a conventionally known manner.

As illustrated in Fig. 1, a circumferential slit 49, 50 and 51 is provided between the individual filter elements 2 to 4 and the surrounding pressure pipe 1. These slits are present in order to facilitate the mounting and the replacement of the filter elements 2 to 4. A portion of the product to be filtered does, of course, pass round the first filter element 4, but is prevented from flowing directly from the surrounding slit 51 and further to the succeeding slit 50 by means of the lip seal 39 on the supporting means 21 arranged therebetween. The presence of the lip seal 39 forces the product through the filter member 7 of the helical filter element 4, and the concentrated

portion thereof leaves the filter member 7 and flows between the spokes of the supporting means 21 and into the filter member 6 of the succeeding filter element 3. However, a portion of the concentrate flows directly through the recesses 41 to 48 and directly into the surrounding slit 50. The same procedure takes place at the next supporting means 20. At the last supporting means 19, the concentrate is also forced into the filter member 5 of the filter element, where the portion not filtered off flows on in form of a concentrate.

Thus the recesses 41 to 48 on the rear side of the supporting means 19 to 21 ensure that fresh fluid is continuously fed to the area behind the respective lip seals 39 in such a manner that the fluid in said area is continuously replaced. The latter procedure is also carried out during the periodic cleaning processes, whereby a cleaning fluid is fed through the filtration plant.

The direct flow of fluid out through the recesses 41 to 48 implies during the operation of the filtration plant that a constant and uniform pressure is maintained in the slits 49 to 51 between the helical filter elements 2 to 4 and the pressure pipe 1, and consequently the load on the helical filter elements 2 to 4 is equalized along the entire length thereof. The direct filling of the slits through the recesses implies furthermore that these slits are not to be filled with fluid which first must pass through portions of each helical filter element 2 to 4. Thus the presence of the recesses results in an optimized effect of the helical filter elements and consequently in a prolonged life of said helical filter elements.

The invention has been described with reference to a preferred embodiment. Many modifications can be carried out without thereby deviating from the scope of the invention. The plant can for instance comprise only one helical filter elements or more helical filter elements arranged in parallel.

The recesses 41 to 48 can for instance be of a varying shape and length in the cir-

cumferential direction. Outside the recesses 41 to 48, the rim 31 and the spoke 23 to 30 are substantially plane both on the front side and on the rear side of the supporting means 19 to 21 with the result that they directly abut the ends of the adjacent helical filter elements.

Claims

1. Sanitary filtration plant comprising an oblong, tubular pressure vessel (1), which includes one or more helical filter elements (2 to 4), each helical filter element (2 to 4) comprising a spiral-wound filter member (5 to 7) and a central tube (8 to 10) as well as a supporting means (19, 20, 21) at one end which represents the outlet end while the plant is operating, said supporting means (19, 20, 21) being in form of a wheel with a hub (22), spokes (23 to 30) and a rim (31) and centrally being provided with a transition member (35) which is adapted to ensure a sealing flow connection between adjacent ends of adjacent central tubes (8 to 10), and where each supporting means (19, 20 and 21) comprises plane sides for abutment against the ends of the filter members (5 to 7) of the respective adjacent helical filter element(s) (19 to 21) and along the external periphery is provided with a sealing means (39) for a sealing abutment against the inner side of the pressure vessel (1), characterised in that a plurality of recesses (41 to 48) extending between an opening between the spokes (23 to 30) and the external periphery of the rim (31) is provided in the plane side of each supporting means (19, 20 and 21) being the downstream face while the plant is operating.

2. Sanitary filtration plant according to claim 1, characterised in that a recess extends from each opening between the spokes (23 to 30) of the supporting means (19 to 21).

3. Supporting means to be used in a sanitary filtration plant according to claim 1 with one or more helical filter elements (2 to 4), which include a spiral-wound filter member (5 to 7) and a central tube (8 to 10), said supporting means (19 to 21) being formed as a wheel with a hub (22), spokes (23 to 30) and a rim (31) and comprising substantially plane sides and centrally a transition means (35), which is adapted to ensure a sealing flow connection between adjacent ends of central tubes (8 to 10) and along the external periphery comprise a sealing means (39), characterised

in that the plane side being the downstream face of each supporting means (2 to 4) while the plant is operating is provided with a plurality of recesses extending between an opening between the spokes (23 to 30) and the external periphery of the rim (31).

1/2

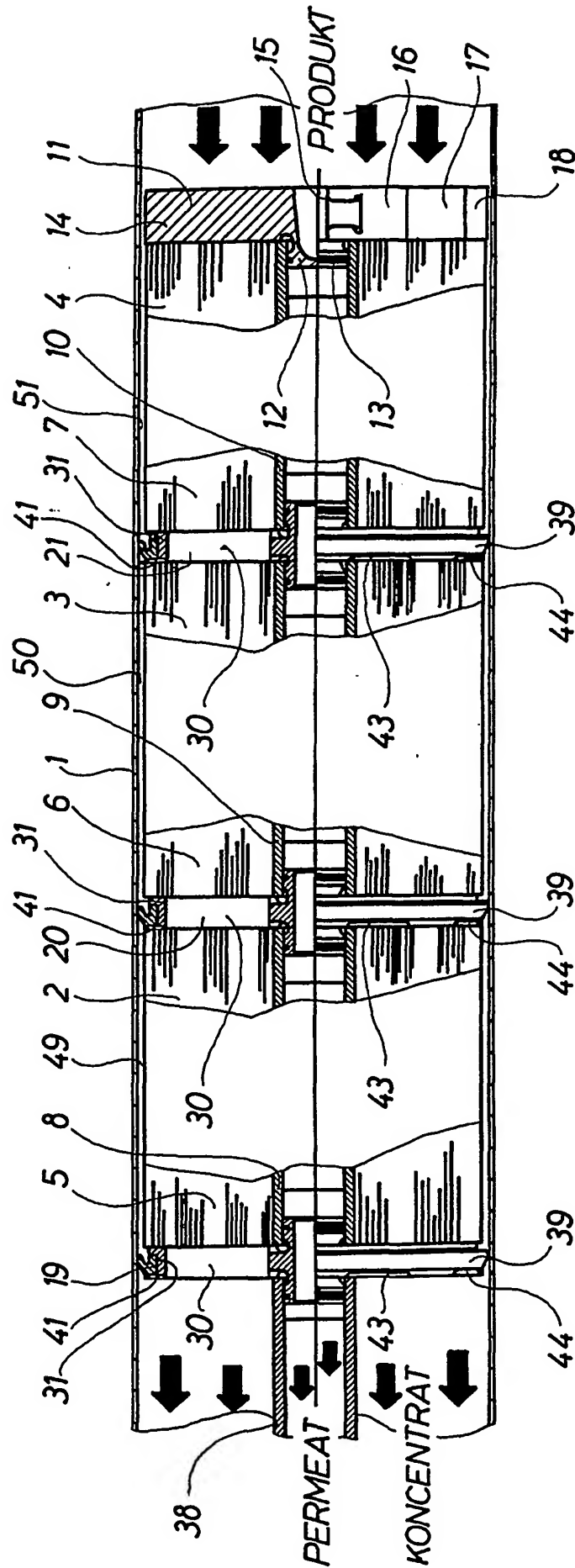


Fig. 1

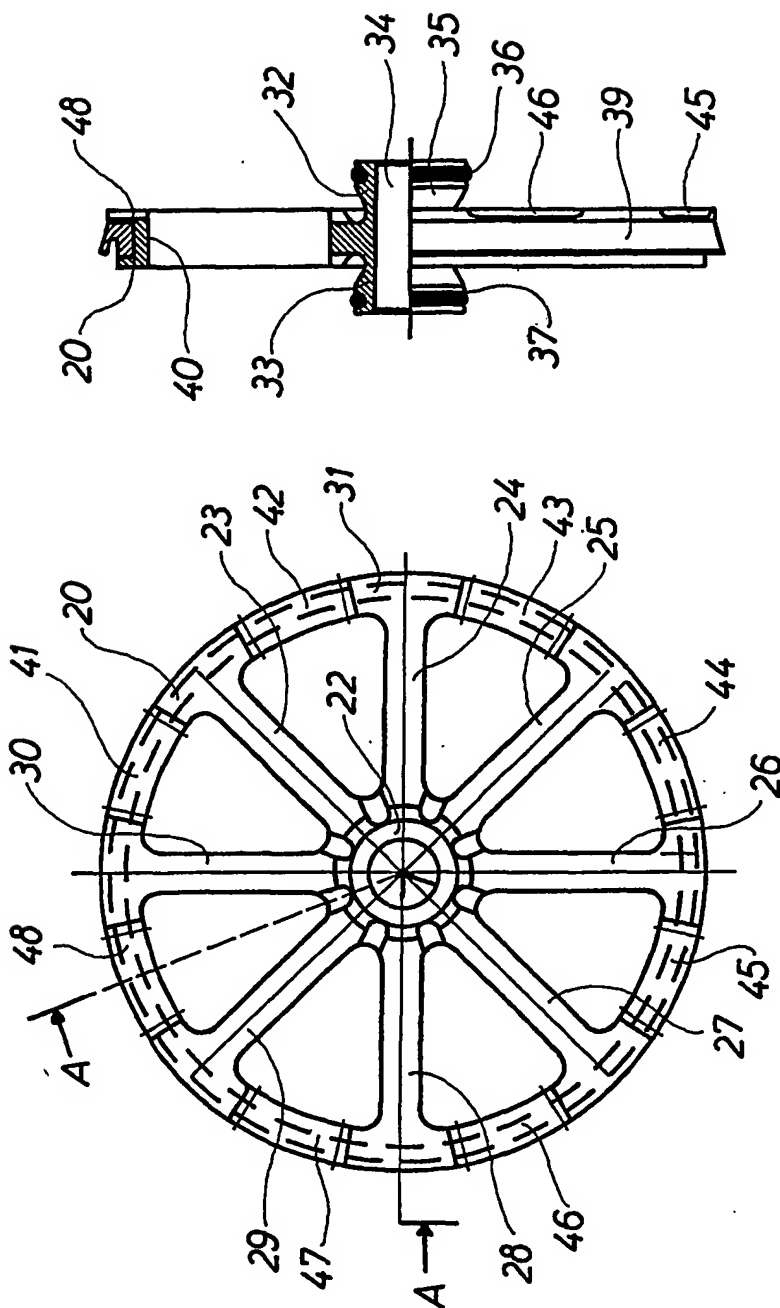


Fig. 3

Fig. 2

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B01D 63/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4517085 A (MICHAEL A. DRISCOLL ET AL), 14 May 1985 (14.05.85) --	1-3
A	US 4237010 A (ROBERT D. ZIMMERLY), 2 December 1980 (02.12.80) --	1-3
A	US 3928204 A (FRANK A. THOMAS), 23 December 1975 (23.12.75) --	1-3

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 March 2002

Date of mailing of the international search report

05.04.02

Name and mailing address of the ISA/
European Patent Office

Facsimile No.

Authorized officer

Jan Carlerud/MP

Telephone No.

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0383146 A1 (W.R. GRACE & CO.-CONN.), 22 August 1990 (22.08.90), column 6, line 2 - column 8, line 45 -- -----	1-3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

28/01/02

PCT/DK 01/00837

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
US	4517085	A	14/05/85	EP	0141201	A	15/05/85
				JP	60087804	A	17/05/85
US	4237010	A	02/12/80	NONE			
US	3928204	A	23/12/75	CA	1051057	A	20/03/79
EP	0383146	A1	22/08/90	AT	98898	T	15/01/94
				CA	2004031	A	14/08/90
				DE	69005326	D,T	14/04/94
				DK	383146	T	31/01/94
				ES	2047723	T	01/03/94
				JP	2245226	A	01/10/90
				JP	2872329	B	17/03/99
				US	4874405	A	17/10/89